NASA STTR 2011 Phase I Solicitation

T2.02   Aeroservoelastic (ASE) Control, Modeling, Simulation, and Optimization

Lead Center: AFRC

This subtopic addresses advanced control-oriented techniques for aeroservoelastic (ASE) flight systems including distributed network sensor systems, modeling, simulation, optimization and stabilization methods of ASE systems to actively and/or adaptively control wing geometry, vibration, gust/turbulence response, static/dynamic loads, and other aeroelastic (AE) objectives for enhanced aeroservoelastic performance and stability characteristics.

Technical elements for these proposals may include:

- ASE enhancements for flight control while minimizing adverse AE interaction.

- Flexible aircraft stabilization and performance optimization.

- Modeling and system identification of distributed AE dynamics with aircraft flight dynamics.

- Sensor/actuator developments and modeling for ASE control.

- Uncertainty modeling of complex ASE system behavior and interactions.

- Distributed networked control schemes for wing shape, vibration, and load control.

- Boundary-layer, shock, and viscous flow sensing with AE control feedback.

- Mission/maneuver adaptivity with dissipative optimal energy-force distribution.

- Data-driven multi-objective ASE control with physics-based aeroelastic sensing.

- Compressive information-based sensing.

This subtopic also addresses capabilities enabling design solutions for performance and environmental challenges of future air vehicles. Research in revolutionary aircraft configurations include lighter and more flexible materials, improved propulsion systems, and advanced concepts for high lift and drag reduction. This subtopic targets

efficiency and environmental compatibilities requiring performance challenges and novel control-oriented techniques for aeroservoelastic considerations which are gaining prevalence in advanced aerospace flight vehicles, atmospheric and extra-terrestrial.

Development of distributed sensory-driven control-oriented ASE systems is solicited to enable game-changing flight vehicle concepts and designs that manage aerostructural dynamic uncertainty on a vehicle's overall performance. This subtopic will assist in revolutionizing improvements in performance to empower a new generation of air vehicles to meet the challenges of Next Generation Air Transportation System (NextGen) concerns, concepts and technology developments in systems analysis, integration and evaluation.

Higher performance measures include energy efficiency to reduce fuel burn and operability technologies that enable takeoff and landing on shorter runways. Distributed aeroelastic control allows for robust nonintrusive flush sensing for control near stall and ground effects, accounting for vehicle flexibility. Proposals should describe how such improvements with distributed ASE systems promote new applications of flight with experimental methods to establish validation data in areas comparable to:

- Reduced take-off and landing field length requirements.

- Improved performance with lightweight structures and low drag aerodynamics.

- Multi-disciplinary design and analysis tools and processes to enable reliable, advanced aircraft configurations with control-oriented sensory-driven design concepts for flight near performance/stability limits.

- Transonic and supersonic shock/boundary-layer control in an aeroelastic environment.

- Sensory and control systems for the reduction of ASE uncertainty from hypersonic aerodynamic heat loads, resulting in lower vehicle weight from reduced design margins for thermal structures and thermal protection systems.

- Integration of interactions among the airframe, inlet, nozzle, and propulsion systems using physics-based ASE control-oriented design approach.